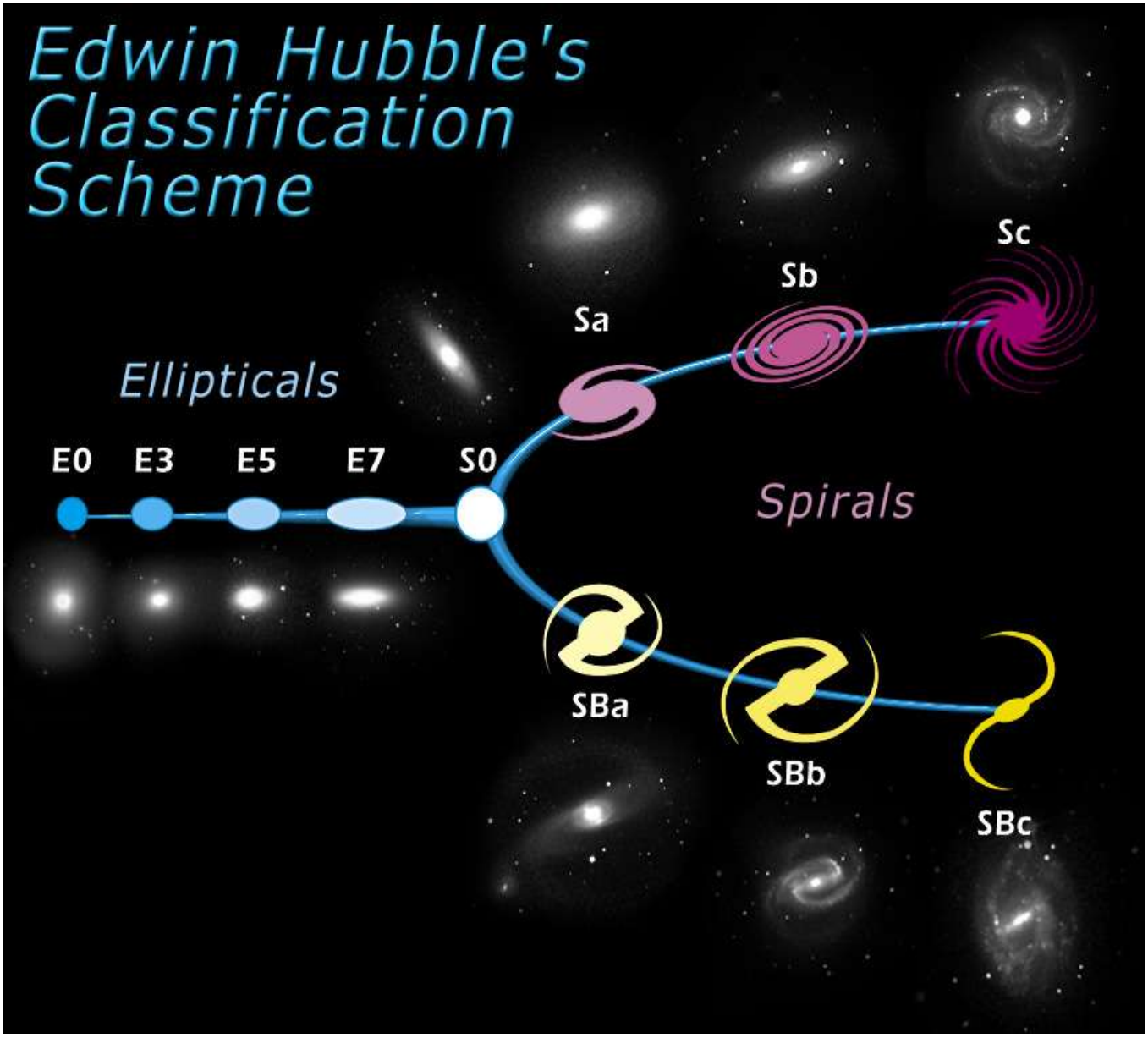
Dwarf Galaxies

Fabio D. Barazza

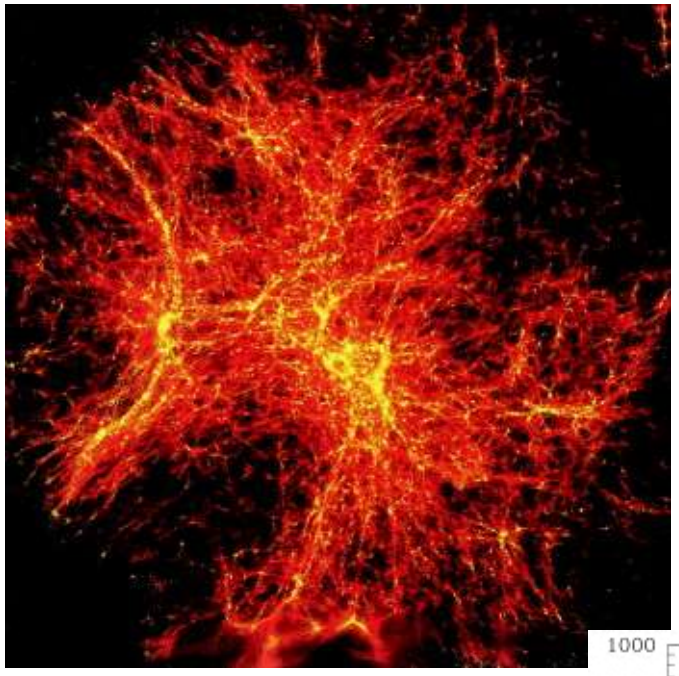

Edwin Hubble's Classification Scheme
Ellipticals
E0
E3
E5
E7
S0
Sa
Sb
Sc
Spirals
SBa
SBb
SBc

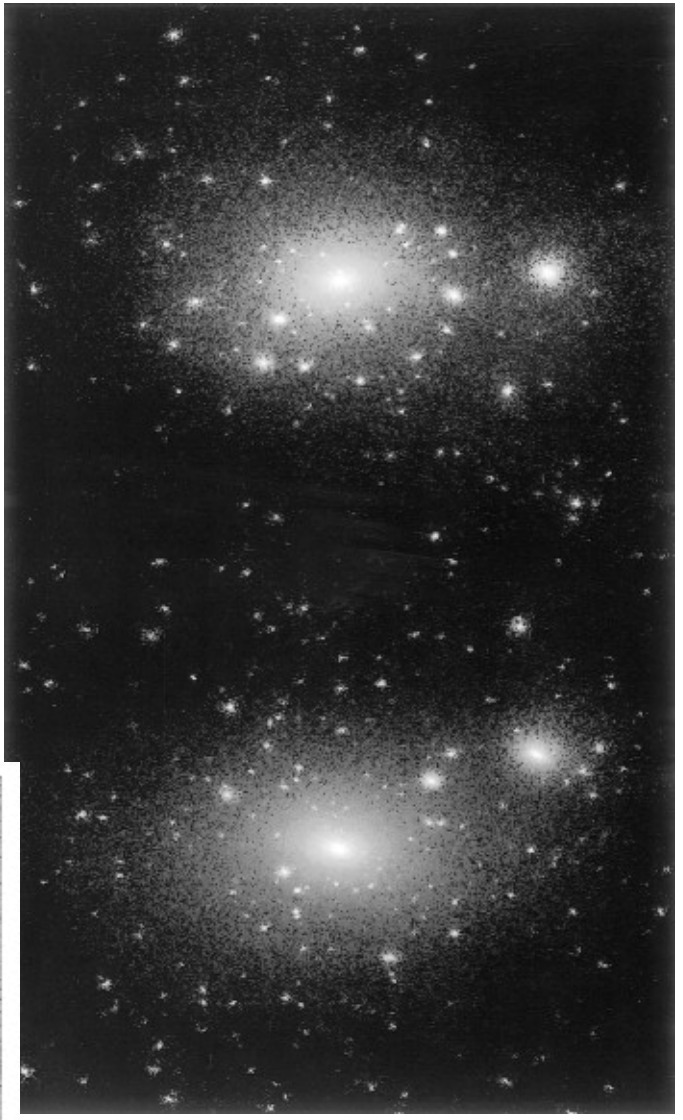
Dwarf Galaxies?

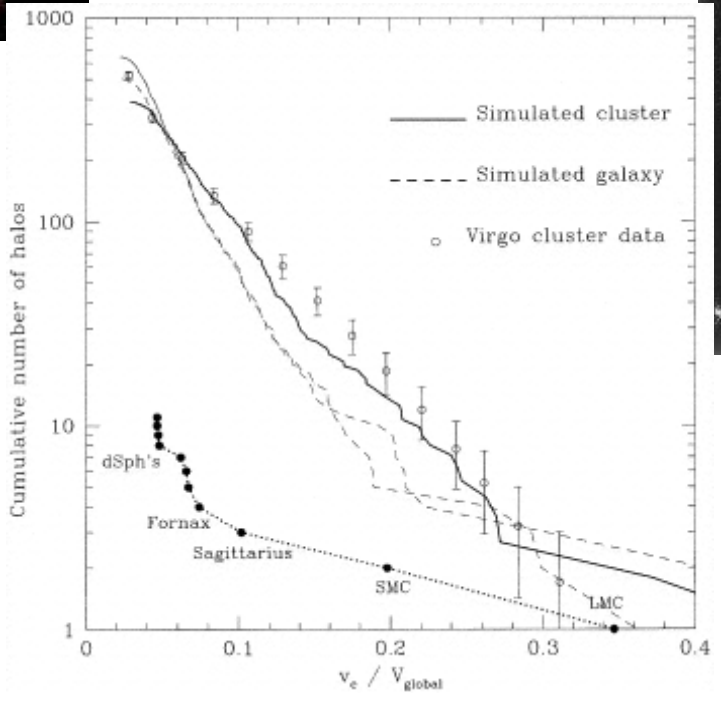
- dwarf galaxies are the most numerous galaxies in the universe (Virgo Cluster: ~2000 dwarfs, Local Volume: ~400 dwarfs)

- dwarf galaxies are the building blocks of larger galaxies

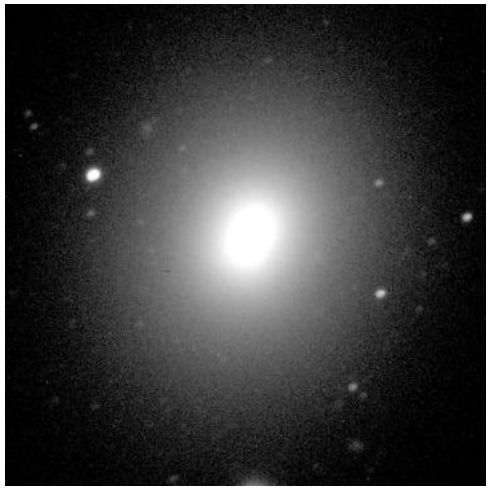
Substructure Problem





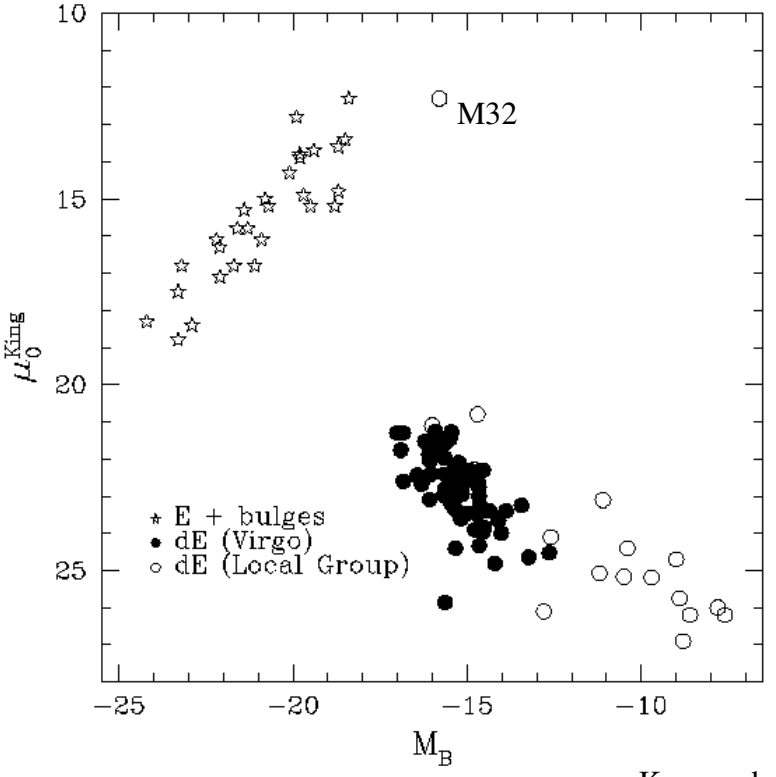


Early-Types



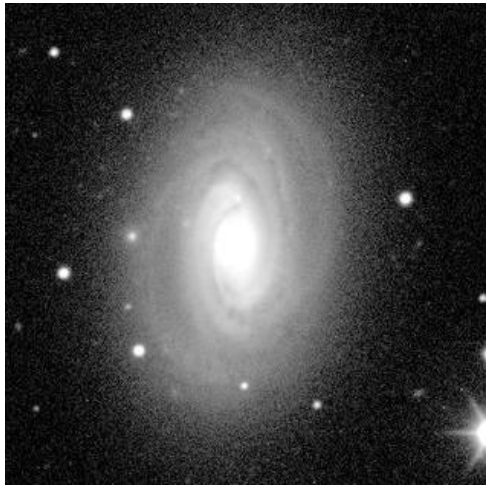
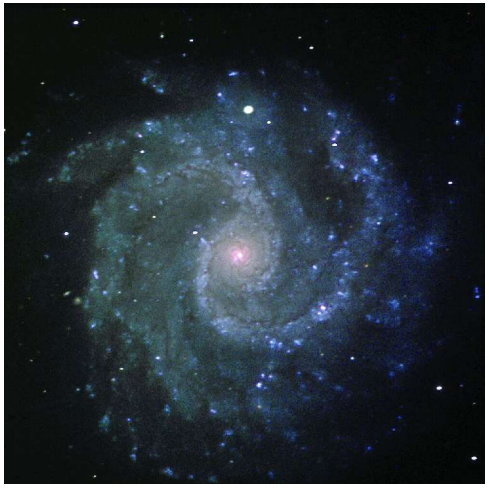
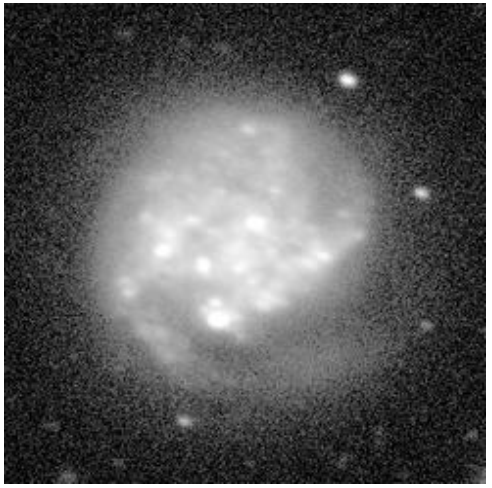
bright ⟷ faint

- giant elliptical galaxies have a steep radial surface brightness profile with high central surface brightness
- dwarf elliptical galaxies (dE) have a nearly flat (linear) profile and their central surface brightness is decreasing with decreasing luminosity



Kormendy 1985

Late-Types

bright ⟷ faint

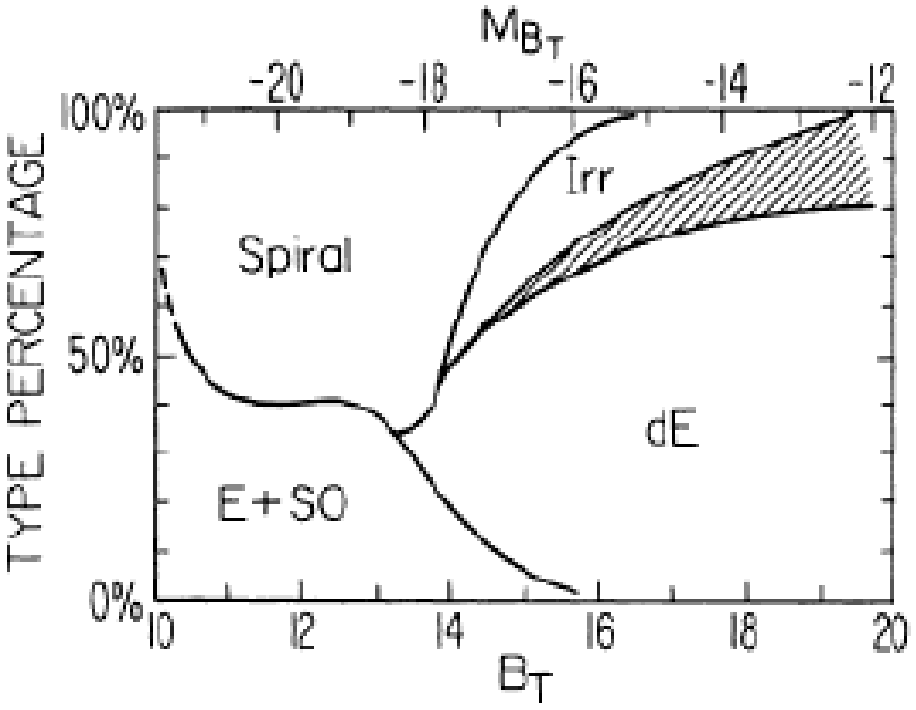
→ loss of bulge → loss of spiral structure

giant:
has a bulge or spiral structure or both

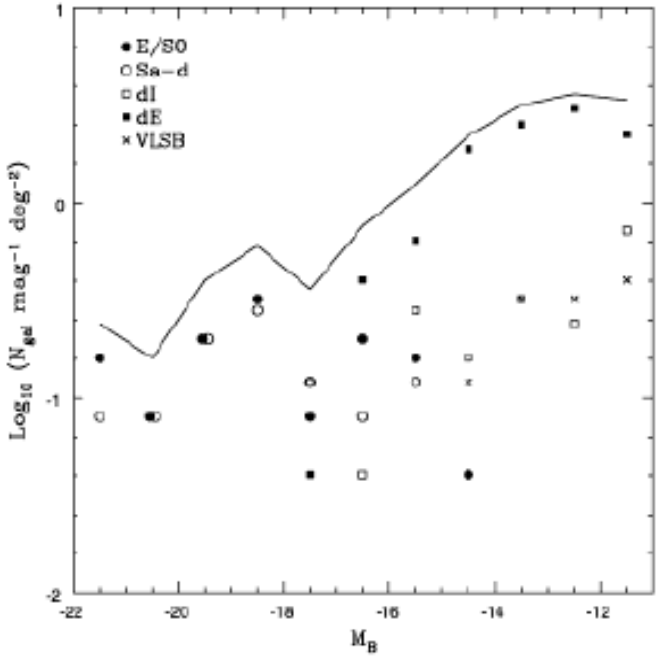
→

dwarf:
has neither a bulge nor spiral structure

The transition between giants and dwarfs



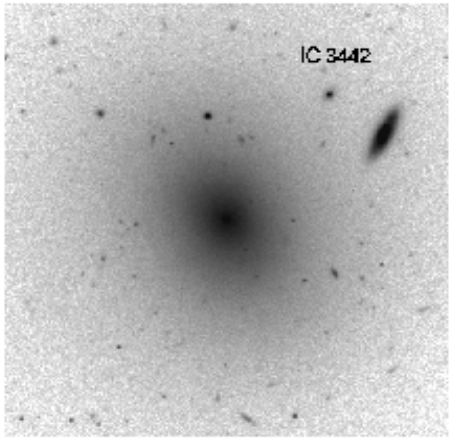
Sandage et al. 1985

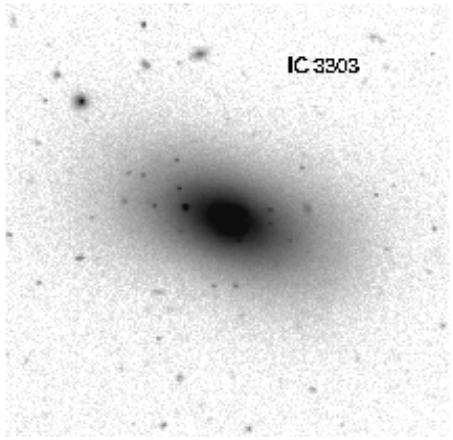


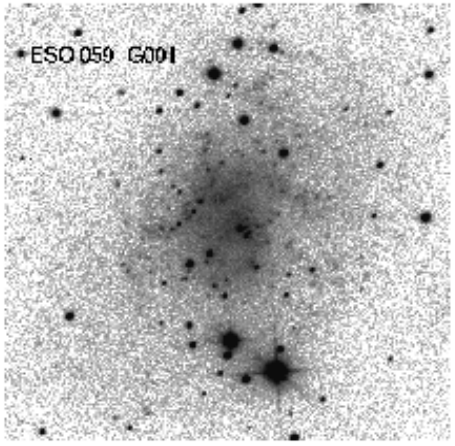
Trentham & Hodgkin 2002

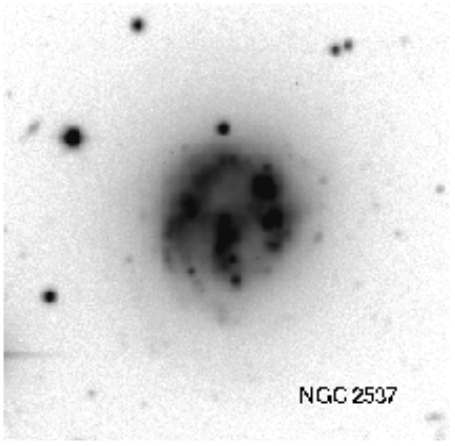
The transition starts at ~-18 mag for early and late type galaxies.
Fainter than ~-16 mag, only dwarfs exist.

Dwarf classification









dwarf elliptical = dE

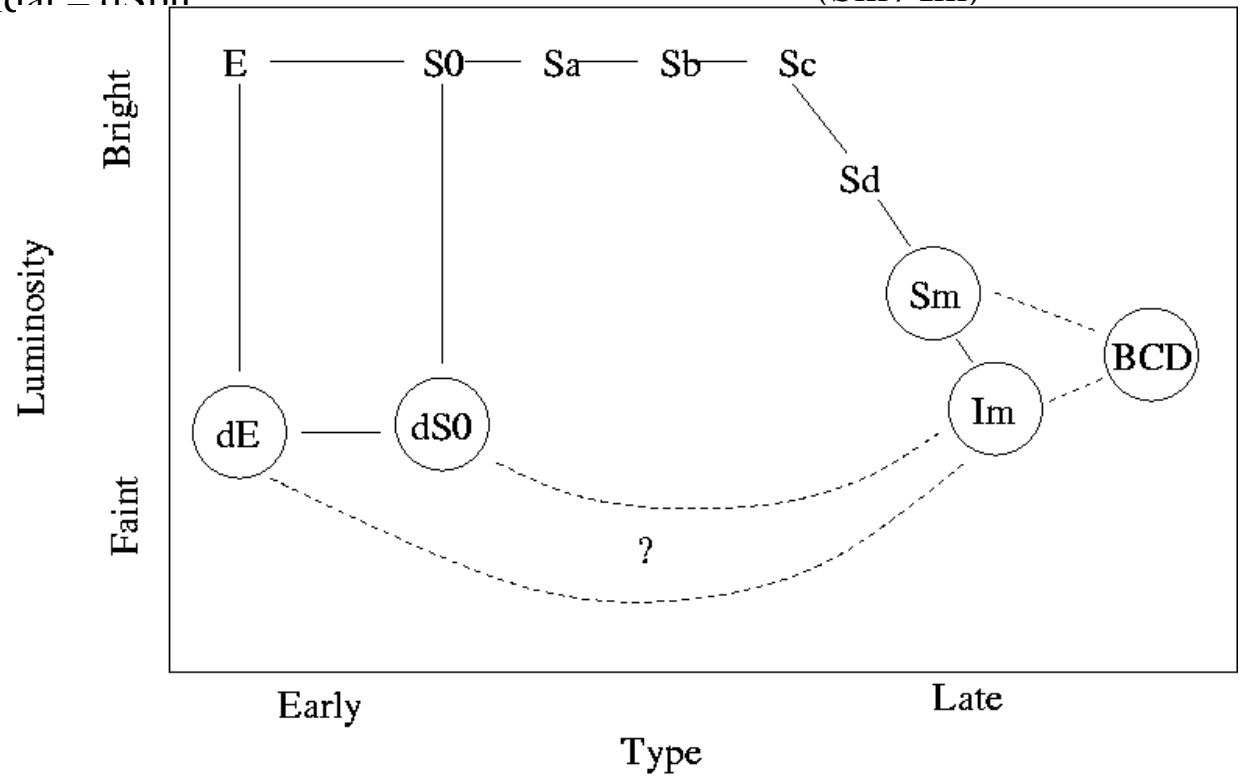
dwarf spheroidal = dSph

dwarf S0 = dS0

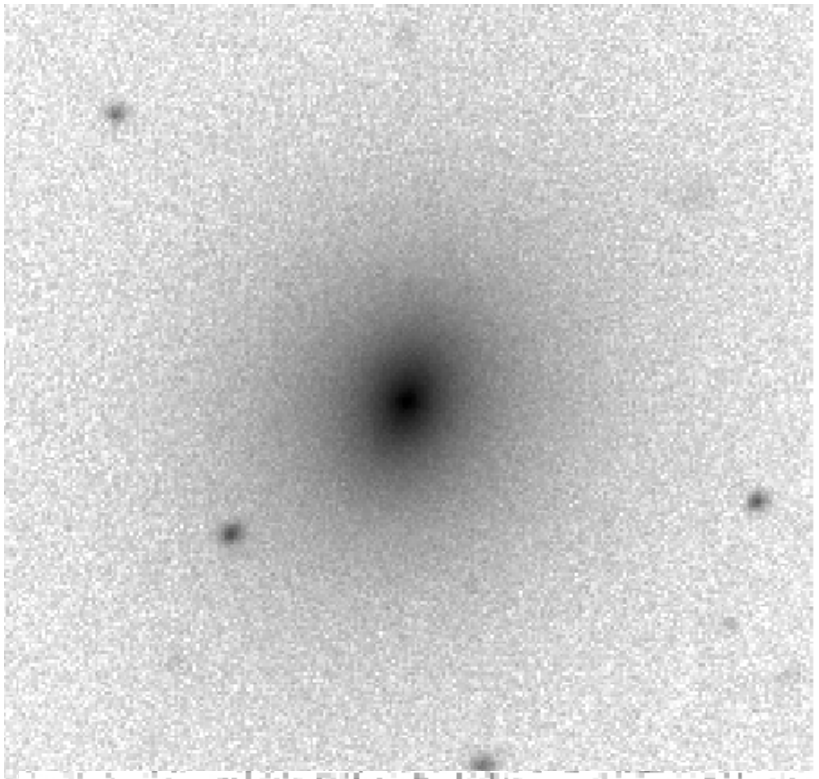
dwarf irregular = dI

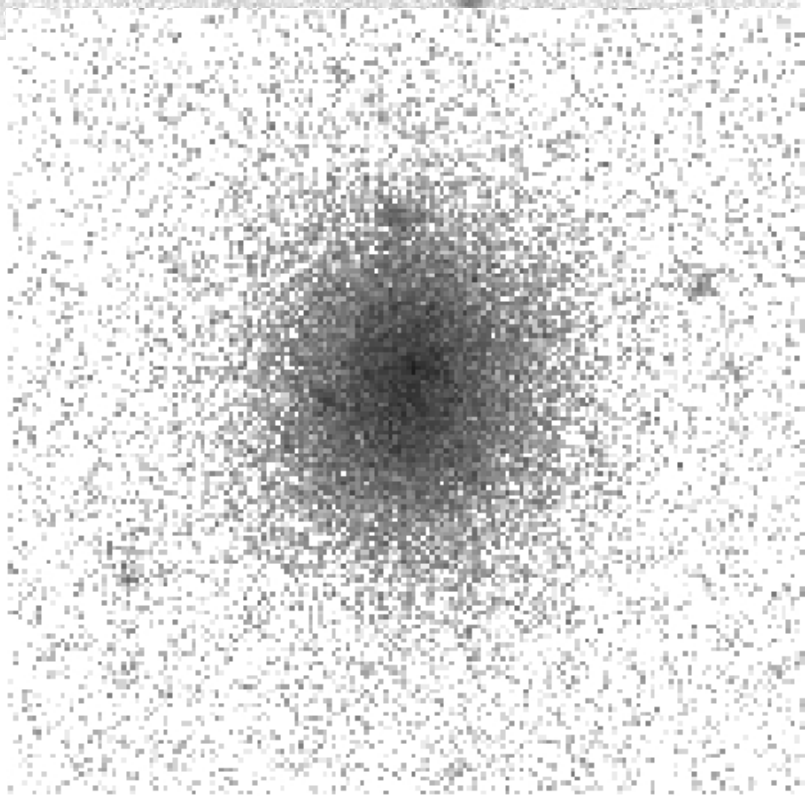
(Sm / Im)

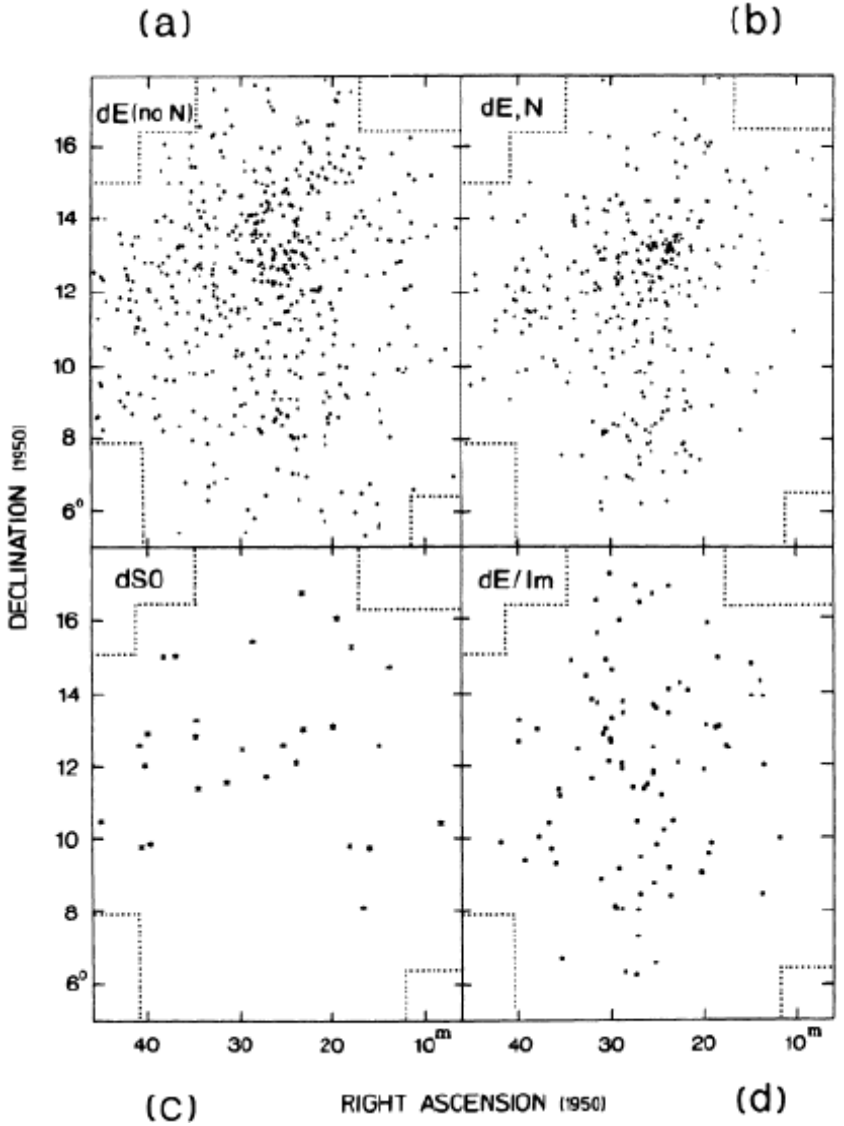
blue compact dwarf = BCD



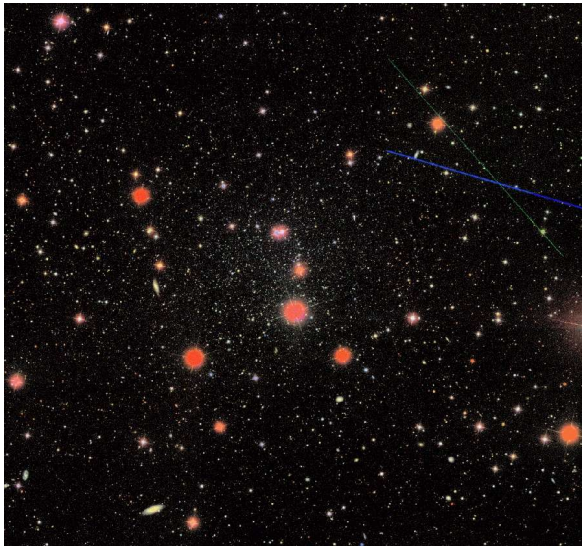
Nucleated dEs







Some properties of dwarf galaxies



Draco

Sextans B

IC 10

- luminosities: -18 mag < M < -8 mag (brightest GC have M≈-10 mag)
- masses: 10^6 – 10^9 M_{SUN}
- effective radius ~1 kpc
- star formation rates: 0.001 – 1.0 M_{SUN} yr^-1 (Spirals have 1-10 M_{SUN} yr^-1)
- internal kinematics: central velocity dispersion: 7-60 kms^-1, rotation: < 2-80 kms^-1
- proper motions in the Local Group: Fornax, Sagittarius, Canis Major

Nearby dwarf galaxies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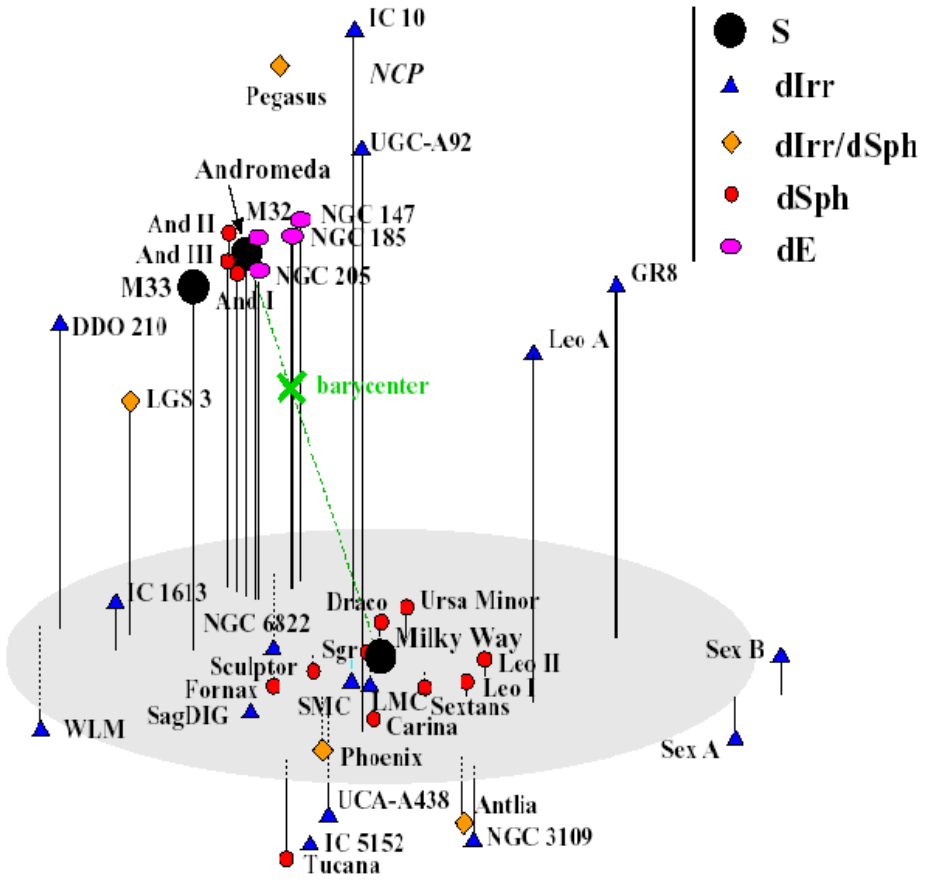
The environment of dwarf galaxies

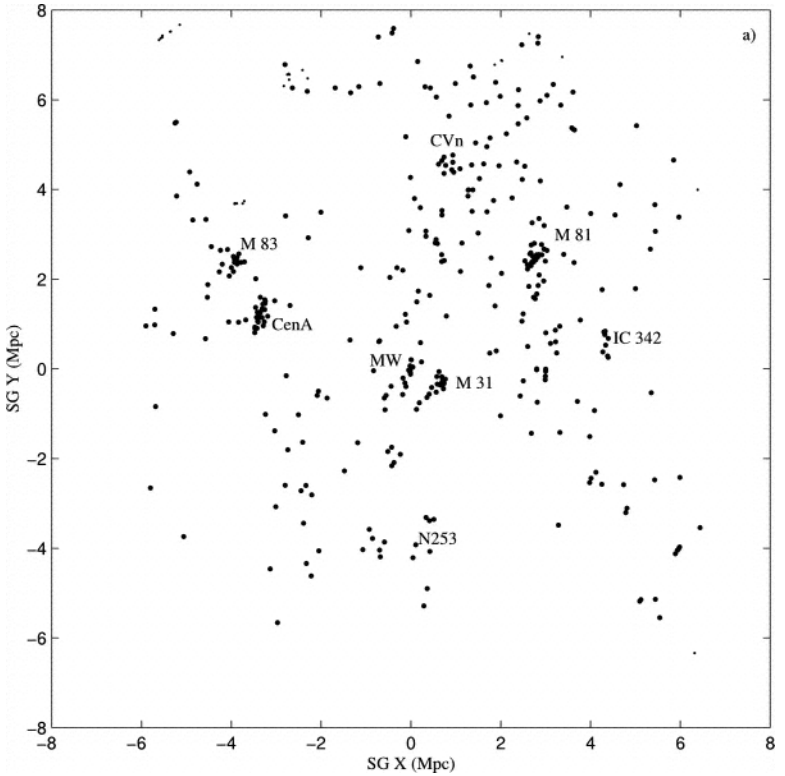


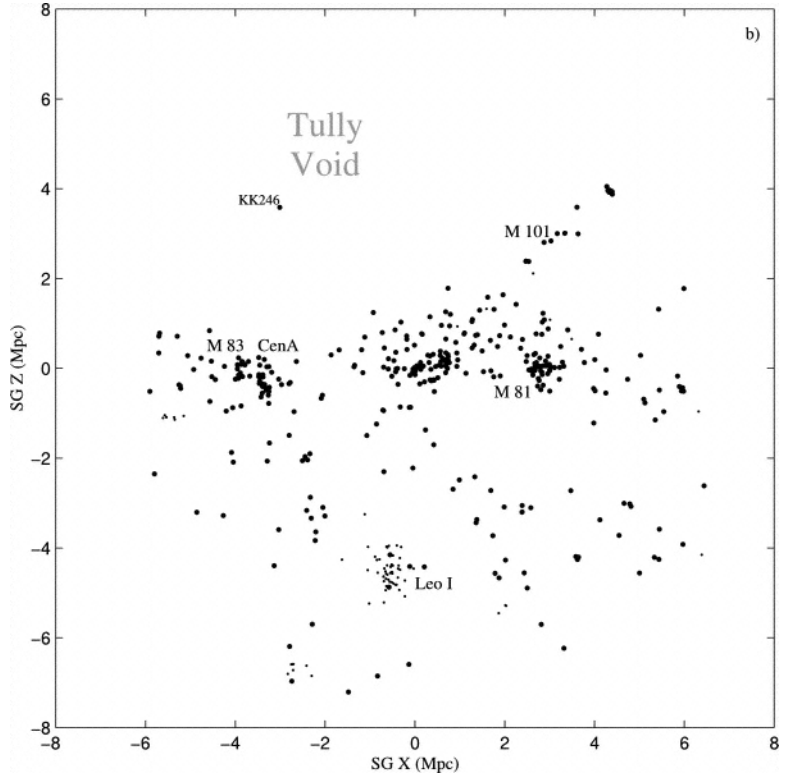
Grebel 1998

~~The Local Group: 37 galaxies, 3-5 giants~~

~~The Local Volume: ~450 Galaxies, dwarf-to-giant ratio ~7~~

The Virgo cluster: ~2000 galaxies, dwarf-to-giant ratio ~20

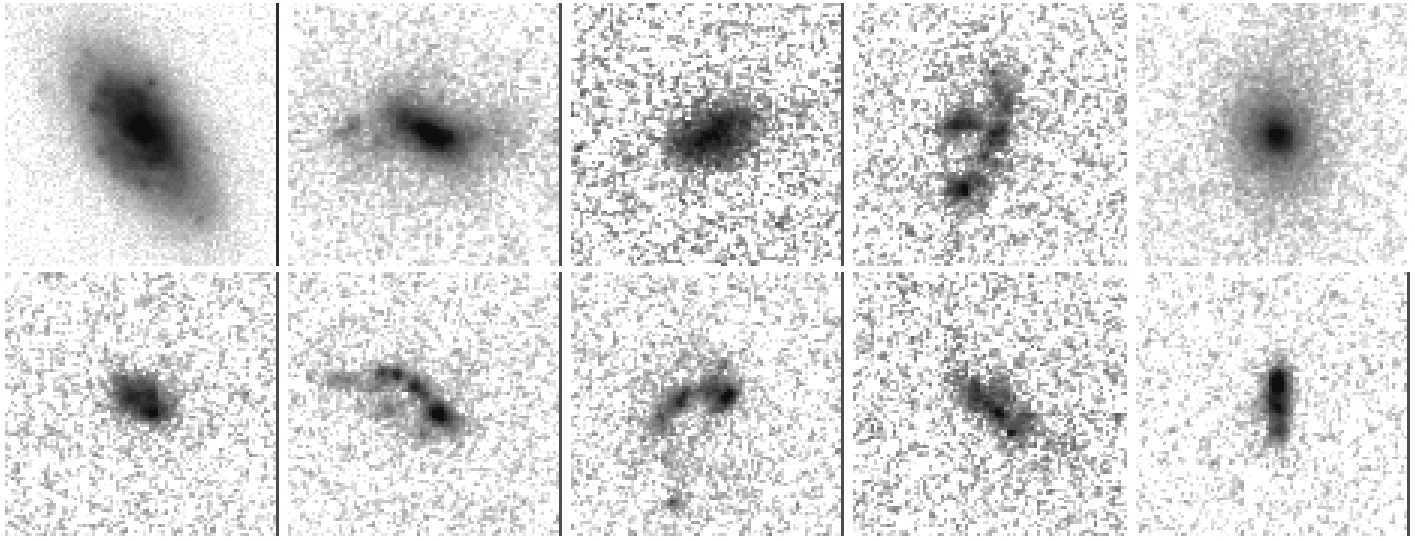




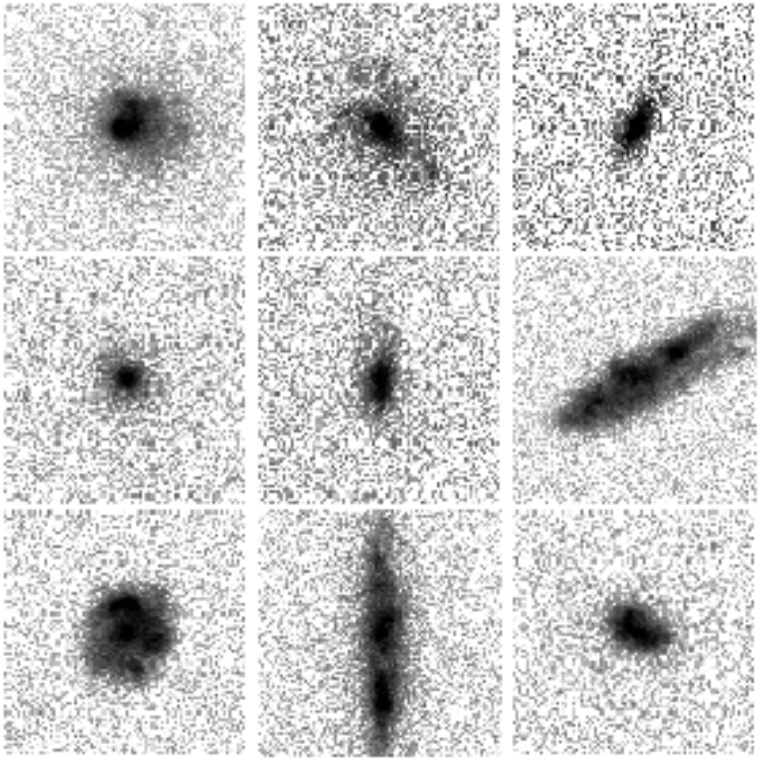
Karachentsev et al. 2004

Examples

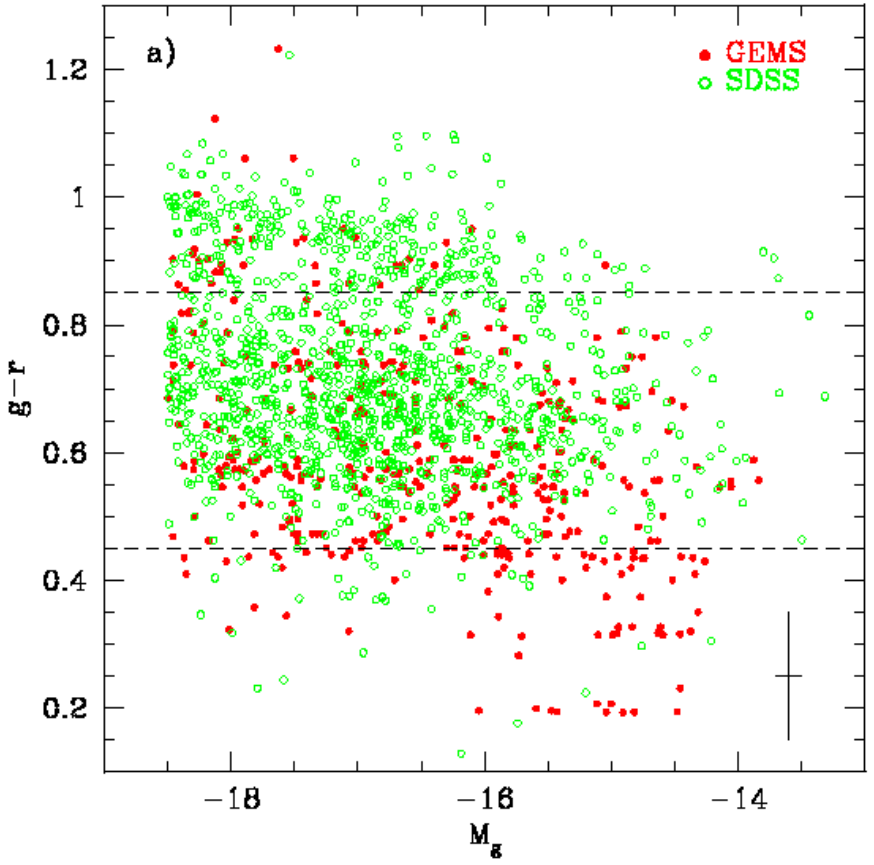
GEMS

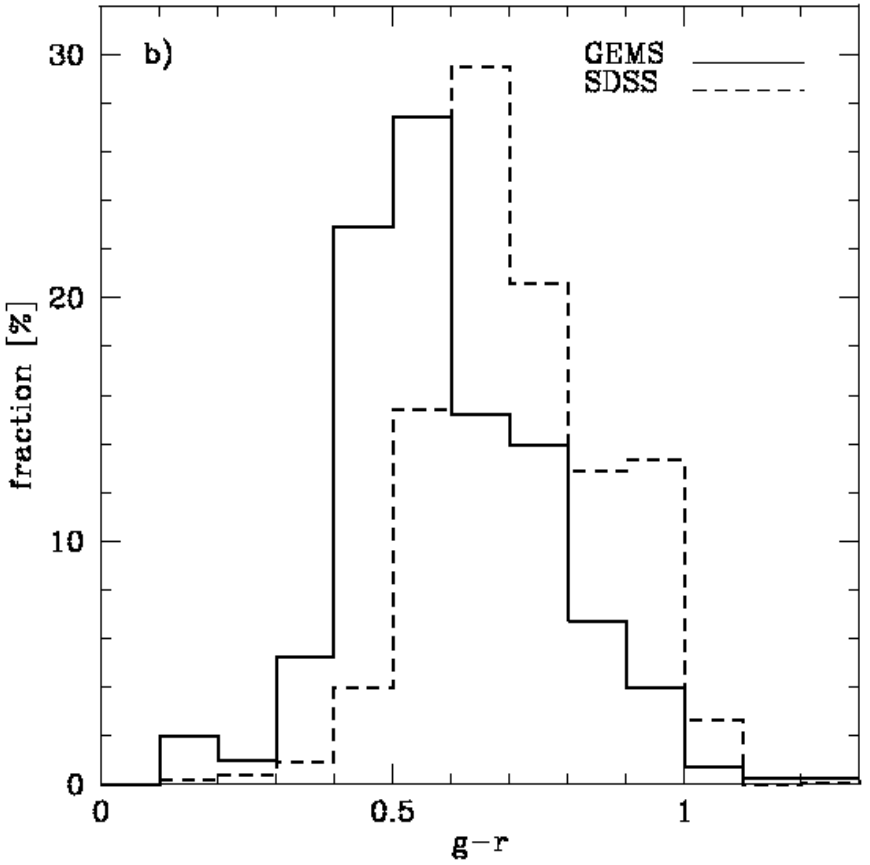


SDSS



Global colors





dashed lines indicate colors of dEs and BCDs

median *g-r* colors:
GEMS 0.57
SDSS 0.70